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PUBLIC WORKS

CITY COUNTY STATE

EXCAVATION OF 100 BY 120-FOOT PIT FOR BRIDGE PIER FOUNDATION

Dragline scraper excavated pit 16 feet deep to suitable foundation, building embankment with excavated material, thus obviating use of sheet-pile cofferdam.

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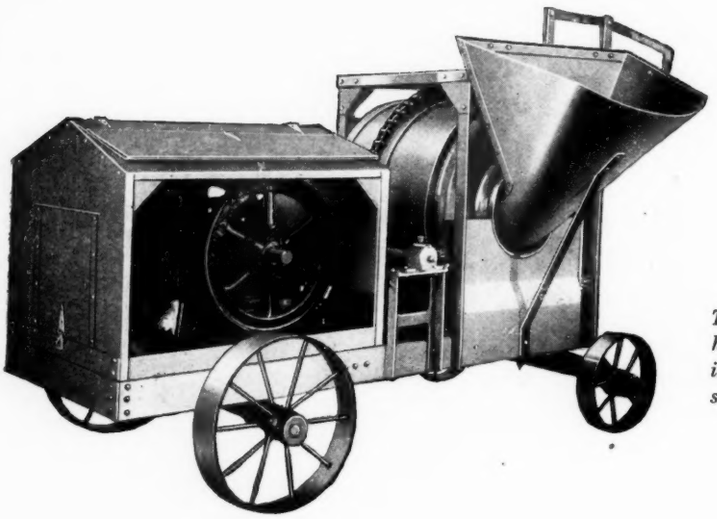
APRIL 30, 1921

GIANT MIXERS



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Vol. 50 **APRIL 30, 1921** **No. 18**

Refuse Disposal in Passaic

By Colin R. Wise*

Dumping of all refuse is to be succeeded by burning in an incinerator plant containing two 42-ton units, with forced draft, ash removal cars and complete equipment. Steam to be created and used for heating hospital building.

Passaic, N. J., a city with about 67,000 population, is about to put a new refuse incinerator into service. Up to this time it has disposed of all of its refuse by dumping, some of it in abandoned quarries or low lots, but the greater part on low land along the river and in an old channel of the river between the city and the channel now followed by the river. The garbage has been mixed by the householders with such refuse as could readily be placed in the garbage pails, other rubbish, such as mattresses, clothing, tree trimmings, etc., being removed if done up in bundles by the householder. The mixed garbage and rubbish was ordinarily dumped to a depth of about 5 feet on the face of a constantly advancing fill and then covered with ashes or earth.

Rats and flies were naturally abundant in and near these fills, but otherwise there was little nuisance created except that due to fire. On several occasions combustible matter in the refuse piles has caught fire and such fires it has been found almost impossible to extinguish. One pile burned continuously for more than two years,

*City engineer, Passaic, N. J.

GENERAL VIEW OF INCINERATOR BUILDING
Approach to the charging floor is along the top of the quarry, at the right.

and the only result of efforts of the fire department to drown it out was to cause the burning garbage to give off fumes and odors that were seriously objectionable.

For collecting the rubbish, the city used ordinary dump wagons, both bottom dump and end dump. A few months ago, however, the city purchased six Lee trailers and automobile trucks for hauling the same and has been using these for collecting refuse while waiting for the completion of an incinerator which has been under construction for several months.

Until the past few weeks the garbage and ashes were not separated. During the month of April, 1912—nine years ago—the ashes and garbage were weighed and their combined weight found to be 956¾ pounds per cubic yard. There had been no weighing since then until the early part of the current month, when the new trailers, with garbage only, were weighed upon the city's scales at the Municipal Building and the weights were as follows: Average weight of trailers, 4,987 lbs.; of garbage and refuse, 427 lbs. per cubic yard. The garbage and refuse collected so far during the month of April indicate that there is now approximately 39.5 tons of matter to be cared for by the incinerator. Of course, as warm weather comes, the volume will greatly increase.

The city slopes up irregularly, but in most places quite rapidly, from the river to several summits about 100 feet above the river. Several quarries have been opened in these hills and one of these has been chosen as the site of the incinerator, which is set in the bottom of the quarry against the vertical face, the top of the quarry being on a level with the dumping or hopper floor of the plant, thus doing away with the necessity for a ramp.

Bids were received on March 8, 1920, for an incinerator of two units, each with a capacity of burning 42½ tons of refuse in 24 hours, the refuse to consist of "material collected by the city carts of Passaic, N. J., including such dry combustible refuse matter as wooden and paper boxes, cut grass, leaves and branches of trees . . . of a mixture made up approximately as follows: 70 per cent of garbage by weight, 30 per cent of rubbish or refuse by weight, and dead animals." The contract was awarded to the Decarie Incinerator Company, which has just completed the plant, having been hindered somewhat by delays in transportation. The price bid was $157,800, this covering the complete installation erected, including a concrete and brick building, a stack 125 feet high, approaches to the building, and the incinerating equipment complete, with provisions for handling ashes and clinkers inside the building.

The builder guaranteed that the amount of fuel required for operating the incinerator should not exceed 50 pounds per ton of refuse consumed, and that not more than 7 men—1 superintendent, 3 firemen and 3 laborers—would be required to operate the plant at its full rated capacity. It also guaranteed that the plant under normal operation will cause no nuisance from the escape of obnoxious odors or gases from either the building or the stack. Also that the refuse will be incinerated to a mineral ash free from organic material.

DESCRIPTION OF THE INCINERATOR

The building contains three floors, one for removing clinkers from the ash pits, another for stoking and otherwise operating the incinerator, and the third floor, above the incinerator, on which the rubbish wagons are driven directly and where they dump their loads into the incinerators, through two hoppers.

The building is 67 feet 8 inches by 40 feet 4 inches outside dimensions and about 45 feet high. Concrete stairs connect the several floors. The floors are of concrete and are sloped to drains that lead to a sewer. Leading to the upper or charging floor are two bridges connecting it with the top of the quarry face, each leading to a doorway 10 feet 6 inches high by 13 feet wide and closed by a steel rolling door. In one corner of this floor are two chutes, one leading to a coal bin and the other to a wood bin. Very little, if any, coal will be required, but broken boxes and other material arriving with the refuse that are especially good for kindling will be dumped into the wood bin for use in starting up the furnace.

In the floor are two hopper openings, one over the center of each of the incinerators (which are exact duplicates), the top of the opening being 6 feet 2 inches by 5 feet 2 inches. Below each opening is a storage hopper capable of holding about 3 cubic yards. The bottom of the hopper is formed by two swinging doors which are held in a horizontal position by a counter-weight, but which can be lowered to deposit all or part of the contents into the incinerator. As soon as refuse has been dumped into a hopper, a cover is placed over the hopper opening so that, when the hopper is being emptied of its contents, air cannot have access to the incinerator to cut down the draft through the grate.

On the floor below, known as the furnace floor, are the incinerators, fans, pump and all the other apparatus except the clean-out doors and the track for carrying the cinder cars by which the cinders are removed from the building.

Each incinerator is 6 feet 8 inches by 10 feet 8 inches outside dimensions. It is composed of a double wall of boiler plate, the two walls being 3¼ inches apart, which space is filled with water when the incinerator is in operation. Inside of this double wall is a large basket grate formed of 2-inch water tubes spaced 12 inches centers, connected near the top of the furnace to the water-jacketed wall and at their lower ends to a header 8 inches in diameter running through the center of the furnace. The water tubes forming this grate are about 4 inches inside of the furnace shell so that the refuse dumped into the basket grate can be dried and partly burned by flames and hot gases rising between this grate and the shell, as well as by the heat from the fire beneath. About two feet below the bottom of this drying water-tube grate are cast-iron dumping grates. On these grates the fires are started with kindling material in beginning the firing of a furnace, and on to these grates fall the dried and

partly burned refuse matters from the basket grate above, and incineration is completed there.

From the dumping grates the ashes and cinders fall into a large ash pit immediately beneath, the floor of which slopes to a clean-out door 30 by 36 inches, the bottom of which is 4 feet above the elevation of a track, the nearer rail of which is 21 inches from the door. Dump cars are run on this track and spotted in front of the clean-out openings and receive the cinders and ashes and conduct them outside the building, where they will be dumped in the bottom of the old quarry.

While the incinerator is in operation, water circulates continually through the water-jacketed shell of the furnace, the header and the pipes forming the basket or drying grate, and the steam created collects in the upper part of the furnace, where the inner and outer shells of the top are about 2 feet apart, thus providing a steam dome. This steam will be used for operating the blowers and pump; also for heating a hospital building located about 500 feet from the incinerator plant, and for furnishing hot water in the plant itself, and in the hospital referred to.

The chimney is built of radial brick, has an inside diameter of 5 feet 6 inches at the top and is 125 feet high. In order to insure sufficiently high temperature to destroy gases and odors and sufficient draft through the burning refuse, two fans are provided, a forced draft fan with a capacity of forcing 41.3 cubic feet of air per minute at 100 degrees Fahrenheit through the pre-heater and into the ash pit below the shaking grates, when operated at 565 r. p. m. against a static head of 3 inches. Also an induced draft fan capable of handling approximately 22,500 cubic feet per minute of gases against a static pressure of 1¼' inches when operating at 467 r. p. m. Each fan is operated by its own steam engine. The gases and hot air from the furnace pass into a combustion chamber, through a fire-brick checker wall 13½ inches thick, and then through a pre-heater and thence to the stack. The flue gases pass through the tubes of the pre-heater, while air from the forced draft fan passes around these tubes and is heated, a temperature of at least 400 degrees Fahrenheit being guaranteed for the forced draft air. From the pre-heater this air passes through a large flue to the ash pit, which is completely enclosed except for the openings in the dumping grates above, and this heated air is thus forced through the burning refuse. By-passes around the pre-heater are furnished which can be used when the fires are started and at such other times as may be desired. All ducts are of steel plate lined with fire-brick and are provided with dust pits and clean-out doors for removing the dust that may collect in them from the flue gases.

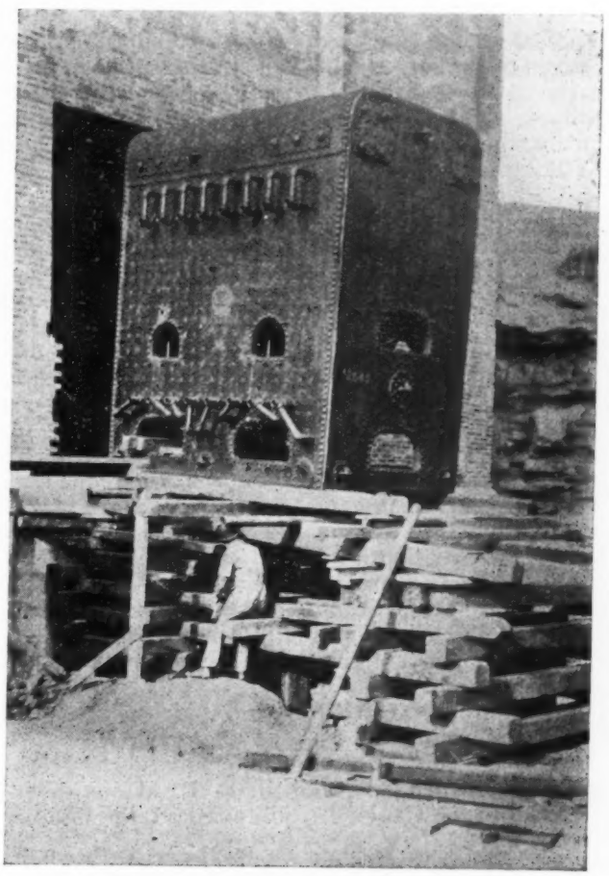
The combustion chambers and pre-heater occupy much more space than does the incinerator, the latter being 6 feet 8 by 10 feet 8, while the combustion chambers and pre-heater combined occupy a space about 14 by 17.

In order to conserve the heat in the water used in the furnace, the return water from the steam pipes is drawn into a 3 feet by 5 feet steel tank, in which is a flow-control valve for admitting city water to make up any losses. From this tank the hot water is drawn by a 5¼ by 3¼ by 3-inch duplex steam pump. An injector also is furnished for filling the boilers. For preventing loss of heat and reducing the temperature in the building, the furnaces are covered down to the stoking doors with 2 inches of magnesia blocks covered with a half-inch coating of cement.

Hot and cold water and steam connections are provided on each floor for cleaning and sterilizing purposes. Electric lights are provided for lighting the building and the interior walls are painted white down to a point a few feet above the floor, thus aiding in giving abundance of light inside the building. A room for the men, containing clothes lockers, toilet, etc., and another to be used as an office by the superintendent, both steam-heated and lighted, are provided at the ends of the main floor.

Studies are now being made for routing the trailers for collecting the refuse. This will be divided into two classes—ashes, and mixed garbage and combustible rubbish. The former will not be brought to the incinerator, but will be hauled to the nearest dumping place. It is probable that a truck and two trailers will be used for ashes, and the other four trailers for collecting garbage. It is intended to use a tractor driver and one man with each trailer.

(*Continued on page* 384)



MOVING INCINERATOR INTO BUILDING

Operating Data of Fine Screen and Imhoff Tanks*

By John R. Downes†

Although there are many Imhoff installations in the country (there are thirty-four in New Jersey alone) few of them are operated with the intelligent care that has been given to this plant by Mr. Downes, and his opinions, based on years of personal supervision, should be of exceptional value to superintendents and operators of such plants.

Four years of operation of the Plainfield, North Plainfield and Dunellen, N. J., joint sewage disposal plant§ have made available some data on quantities of solids removed, both by the Wurl screen and the Imhoff tanks, which data I propose to put before you in very brief form, so that it will be available for reference in connection with future designs. Past discussions of the subject have supplied an abundance of opinion and theory. I shall therefore confine myself to a rather bald statement of observed quantities.

The plant was designed for 40,000 people, and is of the separate domestic type. The sludge separating portion of the plant originally consisted of six Imhoff tanks, each with a total flow length of 64 feet and a total width of 25 feet. Each tank has four longitudinal settling compartments with effective width of 5 feet each. Two gas vents, each 22 inches wide in the clear, extend the entire length of the tank. The walls extend perpendicularly to 5 feet 6 inches below the flow line. The slopes, about 1 on 1, extend to the slot 11 feet below the flow line.

The tanks were put into operation at the end of November, 1916, and operating experiences during the ensuing year indicated the necessity of removing the coarser solids, paper, fiber, hair and fecal matter from the sewage before it was admitted to the tanks; such solids not being amenable to treatment in the tanks. For the purpose of removing these coarse solids a Wurl screen was added to the sludge separating equipment and was put into operation in September, 1918.

The Wurl screen is essentially a brass disk, 10 feet in diameter, revolving on a shaft inclined 15 degrees. The disk is perforated with some 12,000 slots, each 1/16 by 2 inches, and is submerged to about half its depth in the flowing sewage. The solids, which are caught on the surface of the screen, are swept into a trough by the revolving brushes which continually scour the unsubmerged portion of the disk. A one-horse power electric motor which can be adjusted to run at speeds from 600 to 1,800 R. P. M. operates the screen mechanism.

The appended table gives information concerning the suspended solids in P. P. M., as determined by the Gooch crucible method, the number of cubic yards of digested sludge removed from the tanks (measured by shutting off the tank during drawing of sludge and measuring the depression of the water level), the number of cubic yards of air-dried sludge removed from the drying beds (cart measurement), the sewage flow in million gallons and the number of house connections at the end of each month.

Two of the municipalities contributing to the plant were installing sewers for the first time, and the third took in large sections of sewers, so that the increase in number of connections during the first year was very rapid. In order to make the complete sludge data of the four years available for estimation of per capita and per connection quantities, the number of connections at the end of each month have been added together and multiplied by 30 to get the number of connections-days contributing the observed quantity of sludge; five times this figure is considered the number of person-days; this figure checks up well with the known population.

Screenings were measured in a wagon, most of the free water having drained away before measurement was made. The dry solids=11 per cent.

Operating Data on Screen and Tank

YEAR	Suspended Solids P. P. M.		Sludge from		Screenings		Flow		House Connections
	Screen Effluent	Imhoff Effluent	Tanks C. Y.	Beds C. Y.	Total Cu. Ft.	Daily Cu. Ft.	Total M. G.	Daily M. G.	4,500—Start 5,400 6 Mos.
1917	(*)148	37	1,609	586	.....	..	939	2.6	5,853
1918	(*)140	49	3,520	1,090	.....	..	1,253	3.4	6,398
1919	(*)142	38	4,069	877	18,250	50	1,301	3.6	6,804
1920									
Dec.	176	71	.....	12	1,220	47	110	3.6	6,905
Jan.	135	70	.....	.....	1,362	45	109	3.5	6,909
Feb.	123	69	.....	28	1,273	44	100	3.5	6,912
Mch.	116	67	415	.....	1,393	46	133	4.3	6,921
Apr.	157	66	230	97	1,383	46	113	3.8	6,943
May	148	80	248	61	1,364	44	105	3.4	6,969
June	181	57	631	202	1,302	43	93	3.3	6,993
July	175	57	475	92	1,426	46	96	3.5	7,003
Aug.	152	48	523	129	1,420	46	97	3.4	7,036
Sept.	174	65	575	251	1,282	41	96	3.2	7,076
Oct.	193	66	364	109	1,567	52	97	3.1	7,078
Nov.	208	82	346	69	1,359	45	95	3.1	7,111
1920 Avg.	161	66	3,807	1,140	16,351	..	12,430	...	.....

Sludge from tanks = 6 to 4% solids.
(*) = Raw in 1917, 1918, 1919. Higher results in 1920 due to mixing and comminuting effect of screen on the solids. Samples during 1919 were taken before sewage passed the screen.
Bulk of settleable solids = 7% on dry basis and 10% of total settled.
Screenings indicated in above table amount to .0015 cu. ft. per person day.
Digested sludge indicated in above table amounts to .0085 cu. ft. per person day.

At the end of the fourth year of operation a sludge survey of the digestion compartments in-

*Paper read at the meeting of the New Jersey Sewerage Works Association held at the State House, February 18, 1921.
†Superintendent, joint sewage disposal for Plainfield, North Plainfield and Dunellen, N. J.
§This plant was described in our issue for November 29, 1919.

dicated that there remained at that time 750 cubic yards of sludge. In three of the tanks the sludge was at the bottom of the hoppers, and in the other three it was almost entirely floating at the surface of the gas vents (this in spite of constant effort to beat it down).

In addition to the above solids there has been removed from the gas vents a quantity of partly digested sludge estimated at 1,000 cubic yards. This was removed by pumping and by wheelbarrows and ranged in consistency from a watery 96 per cent sludge to a viscous 88 per cent mass, containing much hair and fiber.

The sludge digestion portion of the plant consists of ten sludge hoppers to each tank—these are in two rows of five each—directly beneath the gas vents. The depth between the slot communicating with the settling compartment and the top of the hoppers is 6 feet, providing a total settled sludge capacity of 57,000 cubic feet.

With any operating program which we have been able to develop, there accumulates in time a mass of floating sludge of so slight a specific gravity that it will never settle. I do not refer to the thick, viscous sludge appearing at the top of the gas vents and which may be wheeled off in wheelbarrows, but to a sludge of 95 per cent water content and thoroughly digested. This sludge, floating throughout the entire depth of the digestion compartments and gas vents, is naturally carried back via the slots to the settling compartment by various currents. The result is a black film on the surface of the settling compartment and a very poor looking effluent with an avidity for oxygen which is a serious drain on the sprinkling filter.

It now appears that it will be necessary to pump out the upper portions of the digestion compartments at least once a year, in order to dispose of this digested but unsettleable sludge.

Practically every known method has been tried to prevent foaming in the gas chambers of the tanks. These methods included: Seeding with foreign sludge; application of lime to the sewage in the gas vents; application of water under pressure to scum formation; application of steam; breaking of scum with paddles; covering gas vents so as to retard the drying of the scum; and the reversal of the direction of flow in the tanks. It is the writer's opinion that in order to prevent the foaming of the scum over the top of the tanks, it is necessary for him to operate his tanks in rotation and to pump out the upper portions of the digestion compartments of the tanks at least once a year.

With regard to sludge drying, we find that with 35,000 connected population, we have approximately 4,000 cubic yards of sludge to be removed from the tanks each year.

Our experience shows that it is not economical to put over 9 inches of wet sludge on a bed, since this quantity will dry in a week or ten days of good weather, while any greater quantity will require a time measured in weeks.

It is surprising to find that, in spite of the fact that a coat of sludge 9 inches thick will become spadable in a week or ten days of good drying weather, under actual climatic conditions, we have averaged only a scant 6 dryings per year. The figures for three years are 5.8, 6.0 and 5.8 dryings per bed a year.

Therefore, to dry 4,000 c. y.=108 cubic feet of sludge per year, requires 108,000÷.75=144,000 square feet of drying surface per year, and 144,000 ÷6=24,000 square feet drying area required to take care of 35,000 people under local weather conditions. This amounts to .686 square feet per person.

Operating costs outside of supervision and organization charges are shown in some detail for 1920. It would hardly be worth while to go into operating costs for the other three years on account of the sliding scale value of the dollar, but the proportional distribution will be very nearly the same as for 1920.

It is interesting to note that, outside of interest charges, the comparative costs as between screening and removing the objectionable solids from the tanks by hand are just about equal; that is to say, the time now spent by a watchman on the screen and the cost of power about equal the cost of labor in removing the coarse solids. The plant, however, is much more workable and the nature of the labor much less objectionable when the solids are removed before reaching the tanks.

Outside of the Imhoff tanks and the Wurl screen, which, in view of the above statement, must be considered as a charge against the tanks, one man could do all that is necessary about the plant. To this other work we will suppose the highest paid laborer to be assigned and charge all ordinary labor to care of screen and tanks and to sludge removal.

COST OF OPERATION—1920

	Total	Chargeable to Screen, Tanks and Sludge Removal
Labor	$6,437.66	$4,637.66
Heat, light, power, etc.	1,131.39	240.00
Supplies, tools	1,017.59	1,017.59
Machine repair, tractor, spreaders, etc.	247.05	247.05
Screen, motor repair	186.28	186.28
Gasoline, oil, etc.	370.80	370.80
	$9,390.77	$6,699.38

Expressed in man hours, the labor required to operate the plant is:

For general attention to plant	2450	man-hours per year:
For night watch on screen	5630	" " " "
Care of tanks	5820	" " " "
Drawing and hauling sludge	1242	" " " "
Or General Plant	8	hours week days:
Watch on screen at night	16	" " " and Sundays
Care of tanks	17	" " "
Drawing and hauling sludge	4	" " "

The screen has run practically continuously for two years. The first set of screen cleaning brushes lasted exactly two years before requiring replacement. The speed control apparatus on the motor is the only thing that has given any trouble —$151.01 has been expended to date on this item. Two broken brush flanges, cost for replacement, and a duplicate of each for stock, $38. The current consumption is from 9 to 12 K. W. H. per day.

The maximum (working) loss of head on the screen is 13 inches, and the capacity of the screen with 13 inches loss of head and full screen speed (about 1 R. P. M.) is at the rate of 4,750,000 gallons per day.

Drag-Line Cofferdams

River excavations for piers of a 7-span concrete arch bridge at Dayton, Ohio, made in earth cofferdams constructed by an 85-ton drag-line excavator.

The new Black Street bridge across the Miami river at Dayton, Ohio, has seven 93-foot concrete arch spans supported on two abutments and six intermediate piers, the latter having concrete footings 12 to 20 feet below the river bottom supported on wooden pile foundations. Piers 2 and 3 are adjacent to the deep-water channel and the others are either in shallow water or in the river bottom that is submerged in high water. They have all been built in excavations enclosed by earth embankment cofferdams without core walls or sheet piling. The excavations were made by a submerged scraper bucket depositing the spoil in the levees that form the cofferdam embankments.

The river bottom consists of cemented sand and gravel with occasional clay strata through which, when encountered, the excavation was carried.

The operations were commenced by the installation on a levee, built in the river bed, of a class 14 Bucyrus drag-line excavator with 70-foot boom and 1½-yard bucket. It was mounted on caterpillar tractor, weighed 85 tons and was purchased second hand for $18,000. The excavation was carried down to a depth of about 20 feet below the original surface of the river bottom and the machine advanced without difficulty on the levee that it constructed to form the cofferdam extending around four sides of the pier.

After completing the cofferdam for pier 3, which was the first one constructed, there were installed in it one 4-inch, one 6-inch and two 8-inch centrifugal pumps driven with 30, 40 and 50 h. p. electric motors. The 4-inch pump and one 8-inch pump were operated continuously, the other two intermittantly, to handle a maximum of 4,000,000 gallons of water daily.

Ordinary practice was deviated from by installing the pumps with a normal lift of 20 feet, increasing sometimes to 23 feet, so as to avoid the possibility of flooding the electric motors by water rising in the excavation on the frequent occasions when the electric power was cut off.

The construction of the cofferdam by this method was so successful that it was immediately adopted for pier 4 on one side and then for pier 2 on the other side of pier 3, all three of which were eventually enclosed in one enlarged cofferdam. The sediment brought down by a flood in the river seeped into the levees and silted them so rapidly that the inflow of water into them did not increase and was little larger for the three piers than for the first pier alone. After the completion of these three piers the drag-line proceeded toward the end of the bridge and successively built the cofferdams for piers 5 and 6 that were eventually connected in one. These cofferdams were unwatered by one 18-inch pump with 18-inch suction operated by a 75 h. p. motor. The caterpillar traction of the excavating machine proved very satisfactory for its convenient handling on the tops of the levees and to enable it to be quickly removed in case of flood.

A 9-foot flood causing a swift current through the narrow passage between cofferdams 3 and 4 scoured away 10 feet on the upper part of the levee on one side, but as it did not deposit the material inside the cofferdam, little damage was done and after the levees had been restored by the drag-line machine the excavation was cleared in about 2 hours of hand work and the total delay caused was only about 2 weeks.

ELECTRIC CENTRIFUGAL PUMP UNWATERING ABUTMENT EXCAVATION.
Tripod in sump supports tackle for raising suction to permit removal of obstructions. Horizontal discharge pipe buried in cofferdam levee.

This method of building the cofferdams was considered desirable on account of the rapid handling of the bucket without interference from inside bracing; the greater efficiency of the drag-line bucket as compared with a clam-shell bucket; the elimination of pumping costs during excavation; elimination of sheet piling and bracing costs, and because of the availability of the drag-line machine for service as a locomotive crane for pile driving operations subsequent to the excavation.

Computing Parabolic Curves for Street Grades

By Walter W. Kane*

Time-saving methods of solving problems arising in computing curves for connecting different grades at their intersections.

The writer has devised these two methods as time savers, especially where a number of trial curves have to be taken to give the best results, and agree with improvements on the curve.

I. The tangent rates being given and the tangent points fixed, to calculate the elevations on the intervening stations of the curve; stations equidistant: Divide the difference in the rates (by taking their sum where there is a summit or a pocket and their difference where they are both ascending or descending) by twice the number of stations. Call this result the factor. Add or subtract† this factor from one of the tangent rates so as to make it approach the other tangent rate. This will give the grade rate of the first section on the curve. Then add or subtract double the factor from this rate and proceed until the last station or the tangent point. Adding or subtracting the factor will then give the second tangent rate as a check. Then multiply the rates so obtained by the distances, add or subtract these results, and work from one tangent point to the other.

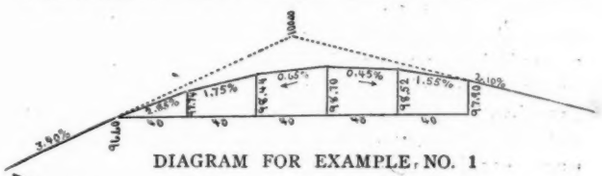


DIAGRAM FOR EXAMPLE NO. 1

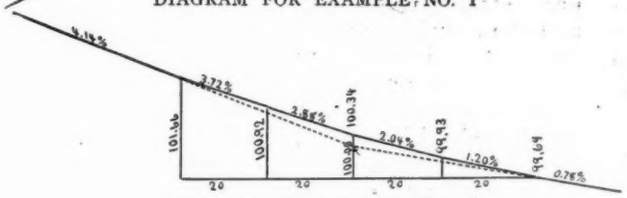


DIAGRAM FOR EXAMPLE NO. 2

*Principal Assistant Engineer, Department of Streets, Newark, N. J.

†By calling rising rates plus and descending rates minus, the factor would always be subtracted and the "add or subtract" ambiguity would be avoided, and the signs used in the calculation of elevations would be obtained automatically.—Editor.

Example 1, with a summit.

Distance between tangents, 200 ft.; number of stations, 5.

$$\frac{\text{Difference in rates}}{\text{Twice number of stations}} = \frac{5.50}{10} = 0.55 \text{ factor}$$

(1)	3.40 tangent rate
Minus	0.55 factor
	2.85 rate ascending
Minus	1.10 double factor
	1.75 rate ascending
Minus	1.10
	0.65 rate ascending
Minus and plus	1.10
	0.45 rate descending
Plus	1.10
	1.55 rate descending
Plus	0.55
	2.10 checks with tangent grade.
(2)	96.60 tangent grade
+ 2.85% × 40	1.14
	97.74
+ 1.75% × 40	0.70
	98.44
+ 0.65% × 40	0.26
	98.70
— 0.45% × 40 —	0.18
	98.52
— 1.55% × 40 —	0.62
	97.90 checks with tangent grade.

This method can also be applied where there is a pocket.

Example 2, grades both ascending or descending.

Distance between tangents, 80 ft.; number of stations, 4.

$$\frac{\text{Difference in rates}}{\text{Twice number of stations}} = \frac{3.36}{8} = 0.42 \text{ factor}$$

(1)	0.78 tangent rate
	0.42 factor
	1.20 rate
	0.84
	2.04 rate
	0.84
	2.88 rate
	0.84
	3.72 rate
	0.42
	4.14 checks with tangent rate.
(2)	99.69 tangent grade
+ 1.20% × 20	0.24
	99.93
+ 2.04% × 20	0.41
	100.34
+ 2.88% × 20	0.58
	100.92
+ 3.72% × 20	0.74
	101.66 checks with tangent grade.

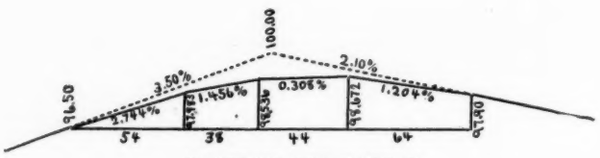


DIAGRAM FOR CASE II.

II. Where the stations are not equidistant: Divide the difference in grades as before by the distance to the first station plus the sum of the first and second, second and third, etc., continuing until the last section is reached, and add the last. Multiply this quotient by the several sums used, and proceed as before.

First station	54
First and second	92
Second and third	82
Third and fourth	108
Last	64
	400

60

400 = .14 factor

		3.50	tangent rate
— .14 × 54	—	0.756	
		2.744	grade ascending
— .14 × 92	—	1.288	
		1.456	grade ascending
— .14 × 82	—	1.148	
		0.308	grade ascending
— .14 × 108	—	1.512	
	—	1.204	grade descending
— .14 × 64	—	0.896	
	—	2.100	checks with tangent rate.

(2)	96.50	tangent grade
54 × 2.744%	= 1.482	
	97.982	
38 × 1.456%	= 0.553	
	98.535	
44 × 0.308%	= 0.136	
	98.671	
64 × — 1.204%	= 0.771	
	97.900	checks with tangent grade

III. Having selected a parabolic grade curve having a summit or pocket, to calculate the position and height of the pocket or summit: Divide the smaller tangent rate by the sum of the tangent rates: multiply by the total length of the curve. This will give the distance from the higher tangent point to the summit. Multiply this distance by one-half the smaller tangent rate, add this to the high tangent elevation; the result is the elevation of the summit.

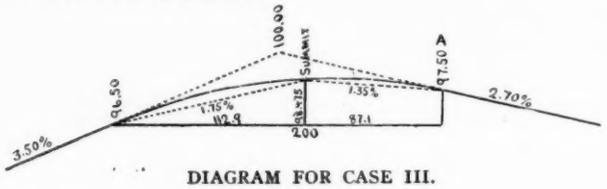


DIAGRAM FOR CASE III.

Smaller rate	2.70	
	——— × 200 = 87.1,	distance from A to summit
Sum of rates	6.20	
87.1 × 1.35	1.175	
	97.30	
Height of summit	98.475	

Check: 112.9 × 1.75 = 1.975

96.50

98.475

This method can be applied to a pocket also.

It will be found that the results obtained correspond exactly with those obtained by parabolic formulas. The methods here employed have the merit of being self-checking.

Concrete in Sea Water

In an experimental investigation conducted by the Aberthaw Construction Company, of Boston, twenty-four large concrete specimens were exposed for 12 years to the alternate action of sea water, atmosphere and frost to determine whether it is possible to make concrete that will completely resist the above conditions.

There were made in the Boston Navy Yard twenty-four 16 x 16-inch specimens 16 feet long without other reinforcement than a ⅝-inch full length twisted steel lifting rod. In the top of each specimen there was bored a 2½-inch hole 8 feet long that was closed with a screwed cap.

The specimens were made of concrete proportioned 1:1:2,, 1:2:4 and 1:3:6, with eight different brands of Portland cement, trap rock broken to pass a 1¼-inch ring and having the dust screened out, and fine sharp sand with about 4.6 per cent moisture.

The concrete was machine mixed dry, plastic, and very wet, in different specimens, was poured in horizontal forms and after five weeks' seasoning was suspended under a pier in such manner that the lower ends of the specimens were always submerged and the upper ends were always above water level. After several months the holes in seven of the specimens were found dry and the remainder contained from 16 to 65 inches of water.

From time to time the specimens were inspected, photographs made, and their conditions recorded. At the end of 12 years five of the specimens "showed little or no effect from their immersion." Of the remainder, one specimen was entirely destroyed and disappeared in the center part, another was half destroyed and disappeared and the remainder were more or less injured, decayed, disintegrated or reduced in size. The test and results are carefully described in a handsome report published by the Aberthaw Company and illustrated with two photographs of each specimen, one taken about 5 years after the test was commenced and one taken after its termination.

The report also includes tests of the neat cement and of the cement mixed with hydrated lime and with pulverized clay and analyses and tests of the stone and sand.

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A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

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Refuse Collection Records

"I do what has to be done as well as it can be done and keep the cost down as much as possible. Why increase my work and the costs by weighing, counting and keeping records of everything?" This in effect is the excuse offered by many a public official for not keeping records. In other cases it is the reason given by the council or other money-appropriating body for refusing to give the superintendent of a municipal service the appliances and assistance necessary for keeping records, even when he, realizing their importance, is anxious to assume the additional work involved.

In the case of refuse collection and disposal, the records are easily kept and are of great use in securing maximum efficiency and economy of service, and yet too few cities keep records that are at all accurate and reliable. Some of the uses of such records that immediately suggest themselves may be considered with profit.

The fundamental record is that of amount of refuse collected. From this we can learn which wagon or other collecting unit is performing the most service, and which is loafing or is so routed that it cannot work full time effectively. By knowing this, a modification of routing may be possible that will save thousands of dollars a year. There should be continous records of the amount collected each day by each driver and the time he delivers each load of refuse at incinerator, dump or other disposal point. With this information in hand and a knowledge of the routes of each wagon, the routing can be modified from time to time so as to maintain maximum efficiency.

Again, in the case of incineration of refuse the efficiency of the incinerator can be known only when the amount of refuse burned is known. Without this it is impossible to know whether it is meeting its guarantee; or to compare it with another of a different type so that, when the time comes to increase the capacity of the plant, the most economical and efficient make can be chosen. Also records of the amounts burned inform the superintendent whether one man operates a furnace more effectively than another, or whether the operator is improving or becoming slack in operating it.

Every load should be weighed. It is impractical to expect a wagon to always collect just a struck load, or always the same amount, and counting wagon loads with an occasional weighing is likely to give errors of 25 per cent; which error will not be greatly reduced by having an employee estimate the percentage each load is of a struck load. In the case of rubbish, a driver can easily double or halve the space occupied by a load by skilful packing or by breaking up boxes, barrels, etc. But the scales cannot be so deceived.

Without regular, continuous weighing of refuse it is not possible to insure maximum efficiency and economy in either collection or disposal by incineration or reduction, nor to intelligently plan for future extensions of service.

Federal Business Conservatism Desirable

Adverse criticism of Federal business, especially that of engineering construction, has sometimes been almost a favorite indoor sport among those smarting from restrictions, delays and decisions that they consider unnecessary and injurious. The contention, however, that public work is generally slower and more costly than private work of the same character is not always true, and when true, is sometimes justified. In order to safeguard public work it is necessary to limit it by many restrictions that have been developed by necessity and long experience. It is impossible to grant to subordinate officials sometimes necessarily poorly qualified political appointees the discretionary powers that may be allowed competent assistants in private work, or to take the risks with public money and public interests that the individual is free to assume for himself.

Critics should realize that in the complicated and varying requirements of engineering construction it is impossible to predetermine all the factors or to arrange in advance for the best good and satisfaction of all the different interests involved. Some private interests will sometimes suffer but it is the duty of the government to protect the public interests and property and to reduce to a minimum losses that it is impossible to fully eliminate.

To do this, careful regulations must be thoroughly and positively enforced, leaving little discretionary power. When this is realized and contractors carefully study the conditions and requirements in advance and are fully prepared to live up to the strict letter of the specifications and contracts, their risks and difficulties will often be found less than in private work. In general the disposition of Federal officers is to get good work, live up to the written requirements, and treat their contractors fairly.

In a recent illuminating address on "The Business of Government," Judge W. W. Warwick, Comptroller of the Treasury, said that the superiority claimed for commercial organizations over established and time-tested methods of government procedure has not been demonstrated; that administrative rules and regulations are required for the performance of all Government business; and that the present condition is as it should be with the safeguards for the interests of the people themselves. He believed that the criticisms of the cost-plus contracts were not justified and he had seen no examples of the system where the contractor got the better of it. Examination has not shown that contractors preferred to pay double wages in order to increase their profits. He believed in a National budget, in the reorganization of the Government executive department, and that the better positions should be given to those willing to make public service a life work.

Efficiency Means Profit on Small Jobs

In a large job where the overhead is heavy and time is of the essence, rapidity is recognized as a very important factor of success and the loss due to an interruption of even half an hour delaying a large force of men is easily understood. In such work there is a good chance for consistent effort to be made, to have the work systematic and well co-ordinated. When this is thoroughly accomplished the contractor seldom makes a profit of more than 20 or 30 per cent on the gross cost of the work.

On small miscellaneous jobs which are often scattered the contractor is properly entitled to make much larger percentages of profit, and if he has plenty of work and does it well he should, besides paying himself a handsome salary, turn over his invested capital very much more rapidly than does the large contractor. To do this most successfully he must keep his plant, equipment and organization constantly at work under advantageous conditions, probably the most difficult result to accomplish and one that is seldom fully achieved.

The small contractor's first aim should be to select a satisfactory line of work, and then to equip himself perfectly for executing it most cheaply and thoroughly train his men to do it in the best and most efficient manner, prepare an advanced schedule for all their operations so that there will be no interference, and secure all materials and supplies at the moment that the work and the men are ready. If this is done the profits will take care of themselves and the contractor will rapidly grow until he can undertake larger and larger work corresponding to his increased resources and reputation.

A large amount of construction work involves concreting and there may be often several simultaneous or immediately succeeding jobs requiring it, that are located from one to thirty miles apart. The delivery of sand, stone and cement by rail is an uncertain and costly operation, delivery by special trucks is also costly and so is mixing by hand for small quantities, even if it is permitted, which is not often the case. A small concrete mixer is not often available for immediate rental in remote localities and its railroad shipment to the place puts it out of service for several days and requires an uncertain amount of time besides the cost of transportation. All of these difficulties have been very satisfactorily overcome by an expedient described in the April 9 issue which is so simple and obvious that it commends itself for a large number of purposes.

A complete storage plant and concrete mixing and spouting equipment is installed on a large automobile truck, making it rapidly portable and giving it a large radius of application. This little plant could transport all of the materials and equipment necessary for a large proportion of ordinary small jobs, together with the men and tools necessary to execute the work, and if these did not suffice could easily be accompanied by a trailer providing the necessary additional transportation at very small cost and no loss of time. Such a peripatetic plant can easily cover an ordinary county, building culverts, pavements, foundations, retaining walls, small bridges and the like to great advantage.

Engineers Wanted for Reclamation Service

Engineers are wanted by the United States Reclamation Service at salaries ranging from $2,400 a year to $1,200. The positions to be filled are those of irrigation engineer, civil engineer and assistant and junior of each of these, and an engineering draftsman. In addition to these salaries, there is a bonus of $20 a month. Applications will be received until August 1 by the United States Civil Service Commission at Washington, D. C., to which applications for examinations may be addressed. The examination will be in effect a sworn statement of the applicant as to his education and experience in irrigation or civil engineering. Those desiring to apply should ask for form 1312 and state what position they desire to apply for.

Oregon State Highway Notes

Some of the more important and interesting points noted in the 1919-1920 Report of the State Highway Commission.

Standard Construction. Standard bituminous construction consists of gravel or crushed rock macadam sub-base, 3-inch bituminous base, and 2-inch bitulithic wearing surface. Standard concrete construction is from six to seven inches thick, the thickness depending upon the traffic to be carried and the character of the sub-grade. Steel reinforcing is used where foundation conditions are unstable. The standard pavement section is 16 feet wide with extra width on curves and superelevation. Two-foot shoulders of crushed rock or gravel have been constructed on all pavements.

It is necessary that all new grades be allowed to settle and be open for travel for at least a year and preferably longer before paving to secure the best results, which will explain why some gaps in the main highways have been left unpaved.

Macadam has, in general, been built 16 feet wide, though in some instances where lighter traffic is expected, 14, 12 and 8-foot widths have been used. The standard width of graded roadbed in average work has been 24 feet, including ditches, and this has been widened to 30 feet in open country where a grader section can be used, and narrowed to 16 feet, including ditches, in the sparsely settled districts and lesser traveled roads where a greater mileage with the funds available was advisable, leaving the widening to a future date when traffic demands.

Work by State Forces. The total of all construction work done direct with state forces totaled in cost $447,850.18, or about 2½ per cent of the total cost of all work done. This work has consisted of grading, macadamizing and bridges, some of which were carried over from the 1918 season. All of these jobs were first advertised and the bids considered unsatisfactory.

Beautifying Highways. The matter of beautifying the highways has had consideration from the commission and it is thought that this feature should be given more attention in the future. The proposal to plant trees along the highways as well as the plan to secure a belt of standing timber on each side of the roadway through the forests and thus preserve the natural beauties for later generations is heartily supported by the commission. Also alongside of the highways are many ideal camping places. It is thought that some means should be taken to secure a reasonable number of these choice spots for camp sites which need not be large but sufficient in size to accommodate several camping parties.

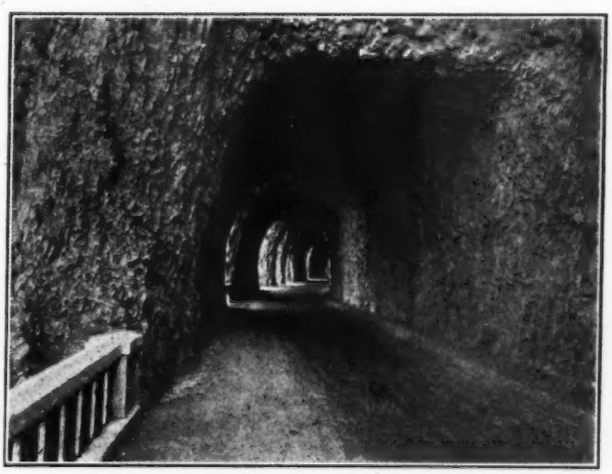
The commission has instructed its engineers to remove all advertising signs within the highway limits as provided by the law so that the highways themselves are free from advertising except, of course, those signs which are on private property.

Oiling Sand Slopes. An interesting feature of the work along the Columbia river between The Dalles and Pendleton treated as a maintenance feature has been spraying of crude oil on the slopes of embankments and excavation as well as alongside the highway to keep down drifting blowing sand. This work in connection with similar work by the railroad has been very successful.

Engineering Expenses. It is thought that the engineering expenses for the years 1919 and 1920 will compare favorably with the costs in other states. The administration and supervision amounted to 1.76 per cent of the total expenditures; the surveys for state highways, 2.04 per cent; construction engineering, 5.11 per cent; engineering on county construction, 0.44 per cent; market road engineering, 0.14 per cent; or a total of 9.49 per cent for the two-year period.

Columbia River Highway. While the surfacing of the Columbia River highway has represented a task of considerable magnitude, the grading of this great highway has not only been much more costly than the surfacing, but has presented much greater difficulties. For many miles it has been necessary to construct the roadbed for this highway upon the rugged and almost vertical walls ot the Columbia River Gorge, necessitating that the roadway be literally carved out of the solid rock. In many places the rock bluffs overhang the finished highway, and at no less than six places it has been necessary to tunnel through rock points which could not otherwise be overcome. For almost its entire length, the highway presents a series of concrete bridges, rock walls, overhanging rock bluffs, tunnels and other construction features of great interest from an engineering as well as from a scenic standpoint. The grading of this highway, now practically complete, represents what is probably the most difficult and costly piece of highway construction yet undertaken in America.

(Compare with the last sentence the following from the 1920 report of the New York Highway Commission, referring to the road along the face of Storm King, which cost $697,505 for 4.03



MITCHELL POINT TUNNEL, OREGON

miles: "This will be the highest cost road not only in this state, but in the United States.")

Bituminous and Concrete. Following out the apparent intent of the legislature as expressed in the several laws governing state highway work, the Highway Commission in awarding paving contracts has made it a practice to consider, on a competitive basis, two or more types of pavement for each paving job. Every job has been thrown open to competitive bidding on both concrete and bituminous pavements, and the award has always been made for the type upon which the lowest total bid was received. The thickness and general make-up of each type has necessarily varied with the condition of sub-grade, the character of available materials, and the class of traffic to be carried, and there has been a gradual tendency toward heavier types of pavements to meet traffic conditions which are continually becoming more and more severe.

Except where sub-grade conditions are unusually favorable, as on sections having heavy gravel or broken stone surfacing of sufficient width and at proper grade to form an absolutely rigid foundation, it is now standard practice to specify for bituminous pavement a thickness of 8 inches consisting of a 2-inch bituminous wearing surface, with a 3-inch bituminous base, on a 3-inch broken stone macadam sub-base, and for concrete pavements, a thickness of 7 inches. It is generally considered that there is little to choose between these two types of pavement, each type having advantages over the other under certain circumstances.

From the standpoint of cost, the two types of pavement are as nearly competitive as it is possible to obtain. While most of the pavement constructed by the Highway Commission has been of the bituminous type, no less than 55 miles of concrete pavement has been placed under contract during the past two years. The chief factor which has operated to throw the majority of contracts to bituminous types of pavement is that the paving contractors in this state have been better equipped to lay bituminous pavements than concrete, and for this reason only a very limited number of contractors have been in a position to bid on concrete pavements.

A factor which prevents concrete pavements from being laid more cheaply than bituminous pavement is the excess price which must be paid for cement in this state. For some reason not accounted for by higher cost of production, the price of cement in Oregon has been very materially higher than in either Washington or California. It is practically impossible to secure a basis for comparison of cement prices, but a conservative estimate places the discrimination against Oregon buyers at not less than 20 per cent.

The average cost of pavements completed during 1919 and 1920, based upon final paid amounts under all completed pavement contracts, an aggregate of 189.1 miles, was $1,210 per mile per foot width. This average cost is for pavement and pavement base. It does not include the cost of grading, shoulder construction and engineering.

Broken Stone and Gravel Surfacing. It is the general practice of the department to construct broken stone and gravel surfacing of materials having a maximum size of one and one-half inches. In most cases the materials are separated into two sizes, the base course of the surfacing being constructed from the size from three-fourths of an inch to one and one-half inches, and the top course from the size from three-fourths of an inch to dust. In general, the surfacing is not rolled, the compacting being effected by hauling over the materials as they are placed, with dragging at frequent intervals as the hauling progresses.

It has been found that the construction of waterbound macadam is not desirable, due to the difficulty with which it is maintained. The broken stone or gravel surfacing as laid by the department, with fine materials on top, affords a very good traveling surface and can be easily maintained by dragging. The use of no materials larger than one and one-half inches in size, even in the base course, prevents any possibility of large stones coming to the surface as a result of maintenance operations.

This method of construction cannot, of course, be used under all conditions. Where the subgrade is unusually soft and unstable, it is frequently found to be desirable to use a somewhat larger size of material in the base or to construct a sub-base course of coarse material. It is occasionally found necessary, particularly in the construction of gravel surfacing, to sprinkle the materials as they are placed to assist in compacting.

Broken stone and gravel surfacing has cost on the average about $450 per mile per foot width.

During the year 1919 only five states constructed more miles of paved highways than did Oregon. During the same year only four states expended more state money for road purposes, although in several other states the combined amount of state, federal government and local funds expended under the direction of the state authorities was greater than the combined amount of Oregon.

For the year 1920 complete statistics of expenditures and completed mileages are not available, but it is quite certain that Oregon will rank as high, if not higher, than in 1919. In amounts of state funds available for highway work during 1920, Oregon stood fourth among all the states.

Pennsylvania Highway Contracts Let

Following the rejection of all bids for highways, as noted in our issue of March 19, bids were received by the state highway department of Pennsylvania on March 31 and April 1, and 21 contracts were awarded involving the construction of nearly 84 miles of highways. These contracts are for lengths varying from a minimum of 5,873 feet to a maximum of 39,959 feet, the former having an estimated cost of $89,578 and the latter of $449,940. The costs ranged from about $54,000 to $80,000 a mile, with the majority ranging between $60,000 and $70,000. Mercer county is to receive five of the roads covered by these con-

tracts, on three of which the county commissioners pay the entire cost of construction, involving something over $1,000,000; on a fourth the entire cost is paid by the state, and on the fifth the state pays 50 per cent and the county and two townships split the other 50. In a number of cases where the highways contracted for are within the limits of boroughs, the department pays for 18 feet of width and the boroughs themselves for the additional width.

Patching Concrete Pavements in Macon

One of the difficulties found with the upkeep of concrete pavements is the patching of holes made in the same by wear, or especially those cut in the pavement in connection with the laying of street mains, house connections, etc. The chief paving inspector of Macon, Ga., W. L. Ashmore, believes that by the method employed in Macon such openings can be closed more cheaply and with less evidence of the patch than can be done with any other type of pavement.

Anyone making a cut in the pavements of Macon must first secure a permit and furnish a bond. The cutting of the pavement is done by the parties concerned, but the refilling of the trench and replacing of the pavement are done by city forces under the supervision of Mr. Ashmore and the cost of the work billed against the beneficiary.

First the backfilling is made carefully and thoroughly compacted. The edges of the cut in the pavement are trimmed with a chisel to a depth of one inch below the surface, to secure a vertical edge and eliminate any feather edges at the wearing surface and disintegration around the edges of the patch. Below this inch of trimmed edge the jagged edge is allowed to remain, except that all loose particles are removed and the concrete is thoroughly cleaned and wet before the new concrete is put in place.

The concrete replaced is mixed 1:2:3, the same proportion as the original pavement, and as nearly as possible the same kinds of aggregate are used. Only enough water is used to secure a plastic mix. The new concrete is carried ½ to ¾ inch higher than the pavement surface and is immediately tamped. After 15 to 30 minutes it is again tamped, and this is repeated after another interval of 15 to 30 minutes, the time between tampings being determined by weather conditions. The repeated tampings are considered of special importance as the feature most responsible for securing a perfect bond with the old pavement for its entire thickness. Mr. Ashmore believes fresh concrete will not compact the entire thickness on first tamping, but after it has been allowed to stand for some time the subsequent tampings compress the material firmly against the walls of the old pavement. By the repeated tampings and compressions performed at a time when the concrete has lost some of the plasticity, it is worked and condensed until there is no further shrinkage and a perfect bond is secured with the old pavement. The concrete is then finished with a hand float which is pressed down with sufficient weight to still further compress the fresh concrete. A perfectly uniform surface is secured by striking off the patch with a straight-edge. The fresh concrete is then covered with dirt, which is wet down at intervals and is protected from traffic for four days.

The average cost of these patches has ranged from $3.50 to $5 per square yard, depending upon the size of the patch. Mr. Ashmore reports that patching other types of pavement in that city costs from $6 to $10 per square yard.

War Deterioration of Water Plants

In a recently issued report of the bureau of water of Reading, Pa., is a discussion by Lewis J. Early, record clerk, of the statistics of 29 cities which publish reports in the form recommended by the New England Water Works Association, which data had been compiled by him and were published in tabular form. Only three cities—Erie and Allentown, Pa., and Colorado Springs—metered less than 28 per cent of the services, and only five metered less than 50 per cent. The amount paid by consumers per thousand gallons averaged 10¼ cents, ranging from 3.89 cents in Allentown to 28.5 cents in Reading, Mass.

One of the most significant points noted by Mr. Early, however, was the effect of war prices and economics on the conditions of the plants. Said he: "There is one very striking feature that marks all the reports. That is, the admission that plants have deteriorated." Some reports explain that, owing to the war, there have been no improvements or enlargements, few replacements and a minimum of repairs. Others assign these degenerate conditions to high cost of material and the shortage of labor, and still others to politics, indifference or incompetency. Whatever the cause, the reports are almost a unit in bewailing the failure to keep rates at the proper ratio to maintenance cost, with a sufficient margin to provide for future needs.

"The following excerpt from the report of the superintendent of water works of Lowell, Mass., a city in Reading's class as to population and character of plant, is typical: 'If the department receipts would warrant it, many improvements could have been made; in fact, several times the amount of money expended could have been used for upkeep, not to speak of new work urgently needed. Naturally, the increase in the cost of labor and material has made matters worse, but the basic trouble is due to the fact that the water rates are too low, and until they are increased the necessary maintenance, renewal and construction work of the department is bound to suffer, and the condition of the property, as a water works plant, to deteriorate so that poor service to the public will inevitably follow.'"

Road Work in 1920 and 1921

Last month we obtained, through the courtesy of county and state highway officials, data concerning highway work throughout the United States. Part of this was published in our April 16 issue, the remainder will appear during the next few weeks. In this issue we give the first installment of a table telling the kind and amount of road work done in 1920 and the money spent; also the amount of money available for 1921 and how it is expected to be used. There is also stated the kind and amount of work done in each county by contract and by public employees, respectively, and what it is expected to do in this respect in 1921. The quantities of work are in miles or square yards, unless otherwise stated.

WORK DONE DURING 1920 AND CONTEMPLATED DURING 1921.

Note—Quantities are given in miles or square yards (the size of the number indicates which) unless otherwise stated.

	During 1920			During 1921		
County and State	Money spent for hwy. work	Kind and amount of surface laid	Amt. done by contract & by employees C—contract E—employees	Money available for hwy. wk.	Kind & amt. of surface to be laid	Amount to be done by contract and by employees C—contract E—employees
Alabama:						
Calhoun	$122,532	Grading ½	All E	$50,000	Only maintenance	all E
Conway	750,000	mac., 6, gravel 8, crushed rock 25	all E	600,000	mac. 22, gravel 5, 50 mi. prob. mac.	all C
Jefferson	.....	131,279 warrenite bit.	....	.....	.....	.....
Monroe	21,601.64	gravel 7	all E		gravel 24¼	all C
Montgomery	325,000	conc. & maint. of 450 gravel	$90,000 bridge C rest all E	200,000	maint.	all C
Pike	60,000	45,000	all C	60,000	.....	all C
Arizona:						
Flagstaff	.....	6,000 war.-bit.	....	.....	.....	.....
Maricopa	.....	15,444 war.-bit.	....	.....	.....	.....
Yuma	.....	1,010 war.-bit.	....	.....	.....	.....
Arkansas:						
Arkansas	.....	39,667 war.-bit.	....	.....	.....	.....
Jackson	400,000	gravel 30	all C	400,000	gravel 30	all C
Lincoln	100,000	gravel 20	all C	Indef.	gravel 33 1-3	all C
Lincoln, Drew, Desha, Chicot & Ashley	1,500,000	broken stone 12, mac. 20, topeka 50	all C	1,225,000	gravel mac. 50	all C
Phillips	.....	24,499 war.-bit.		.....	.....	.....
Polk	45,000	gravel 9	all C	500,000	gravel 50	all C
Pulaski	2,250,000	conc. 6, asp. conc. 10 warrenite 7, sh. asp. 3	all C	3,500,000	asp. conc. 18, conc. 22, 2 bridges	all C
Saline	170,000	gravel 20	all C	Indef.	gravel 33 1-3	all C
Scott	15,000	none	.....	40,000	repair & maint.	all E
Sevier	110,000	gravel 20	all C	Indef.	grav. 33 1-3	all C
Van Buren	200,000	grading & drainage	all C	100,000	19 mi. started in 1920	all C
California:						
Fresno	2,150,000	asp. conc. 65, mt. rd. reconstr. 50	mt. rd. 50 E asp. conc. 65-C	2,650,000	asp. conc. 70	all C
Glenn	150,000	conc. & oil mac.	all E	160,000	.....	all E
Madera	70,000	dirt, gravel	all E	80,000	.....	all E
Santa Cruz	.....	16 conc.	....	.....	20 conc.	.....
Solano	190,000	repairs 45, conc. 1	....	350,000	$37,000 asp. conc.	.....
Sutter	269,838.18	3½ conc., 15 asp. mac.	½ asp. mac. E rest C	760,000	6 conc., 33 asp. mac.	5 asp. mac. E rest C
Ventura	600,000	14 bit., 13½ cem. conc.	all C	200,000	14 asp. surfacing, 5 grading, 2 oil mac.	½ E, ½ C
Yuba	.....	1,757 war.-bit.	....	.....	.....	.....
Colorado:						
Elbert	119,000	gravel and dirt	30 gravel E	92,000	50 dirt	½ E, ½ C
Logan	206,518.30	3,415 lin.ft. conc.	all C	216,657.47	4½ conc.	all C
Ouray	40,000	$1,000 gravel	all C	180,000	$5,000 gravel	gravel E
Rio Blanco	110,000	20 shaled surf.	all C	60,000	1.8 shaled, 10 earth	all C
Rio Grande	125,000	gravel & sand mix.	$40,000 E $85,000 C	128,000	3.5 fine gravel & sand mix	all C
Routt	90,000	earth	67,000 E 23,000 C	160,000	7 gravel & dirt, 1¼ gravel surface	F. A.-C earth E
Wild	455,000	13 gravel, 1¾ conc.	all C	599,000	5 conc., 7 mac.	all C
Connecticut:						
Bethlehem	10,000	all repair	½ E, $1,000 C	20,000	all repair	all E
Greenwich	150,000	2 conc., 2/3 tarvia penetration	2/3 tarv. E 2 conc.-C	180,000	3 conc., ½ pen.	pen. E, conc. C
Hamden	25,000	½ topeka asp.	all C	280,000	5 cement	all C
New Haven	5,000	4 gravel	all C	25,000	2 tarvia top	all C
New London, Windham	671,705.41	34,747 ft. mac., 2,600 ft. conc., 18,290 ft. gravel 106,653 ft. bit. mac., 28,975 ft. rock mac.	24,205 ft. E 167,060 C.	1,370,000	15 bit. mac., 8 conc., ½ rock mac., 4¼ mac.	1-E, 26¾ C
Tolland						
Southington	.....	4,692 war.-bit.	....	.....	.....	.....
Florida:						
Bay	80,000	60 clay-gravel	all C	.....	.....	.....
Bradford	815,000	sand and clay	all E	180,000	.....	all E
Brevard	.....	.....	....	.....	20 mac.	
Duval	200,000	shell	prisoners	300,000	$50,000 asp., rest mnt.	maint. E, rest C
Escambia	118,000	1 cem., conc., 3 bridges	$20,000 E $98,000 C	2,044,000	80 class A const.	all C
Flagler	75,000	grading, hard surfacing	$45,000 C $30,000 E	200,000	hard surfacing	all C

WORK DONE DURING 1920 AND CONTEMPLATED DURING 1921 (Continued)

County and State	During 1920: Money spent for hwy. work	During 1920: Kind and amount of surface laid	During 1920: Amt. done by contract & by employees C—contract E—employees	During 1921: Money available for hwy. wk.	During 1921: Kind & amt. of surface to be laid	Amount to be done by contract and by employees C—contract; E—employees
Florida (continued):						
Pinellas	157,000	5 vitr. brick, 4 oyster shl.,4 lime, rk.shlds.	$57,000 E 1,000,000 C	87,000	5 lime rock base w. oyster shell finish	all E
Idaho:						
Ada	600,000	10 bit., rest gravel	gravel E 10 bit. C	600,000	3 bit., 6 conc. or bit., rest gravel	all C
Bannock	196,277	15 gravel, 15 crushed roc k	earth & 10 grav. E rock & 5 gravel C	250,000	probably like 1920	all E
Bingham	.....	65,000 war.-bit.	....	.....	.....	.....
Boise	21,000	8 dirt	all E	100,000	20 dirt	all C
Bonneville	.....	56,000 war.-bit.	....	.....	.....	.....
Butte	40,000	earth & gravel	$5,000 E $35,000 C	55,000	5 graded earth, 1v gravel	3 earth, 2 grav.-E 2 earth, 8 grav.-C
Caribou	102,243.54	grading & drainage	3 C rest E	none	grading & maint.	all E
Custer	6,000	maintenance	....	96,000	6 grading	all C
Dist No. 1, Bureau Hwys.	340,000	15 gravel, 7 crushed rock, 35 earth grade	26 earth-E 31-C	320,000	1 rock, 20 gravel, 20 earth grade	10 E, 20 grad., 21 surface C
Filer Hwy. Dist.	.....	.....	....	.....	7 conc.	.....
Idaho	425,000	4 mac., 32 earth	all C	528,000	5 mac., 26 earth	all C
Power	120,000	25 gravel	....	158,000	15 gravel	all C
Illinois:						
Adams	150,000	2 mac., 6 gravel	3-E	170,000	30 earth, 35 conc., 3 gravel	gravel, earth E conc. C
Calhoun	none	.....	....	200,000	.....	all C
Carroll	25,000	5 gravel & mac.	all C	6,000	1 mac.	all C
Christian	none	.....	....	60,000,000	oiled earth 200	100 E, 100 C
Clark	622,000	concrete	all C	450,000	gravel or rock	all C
Coles	133,000	1 brick pave., 10 grav.	all C	135,000	1 brick pavement, 10 gravel	all C
Crawford	140,000	1¼ gravel mac., 7 gravel, 3 oiled	2 grav., 3 oil-E rest C	140,000	10 gravel, 2 oil	10 gravel C
De Witt	100,000	50 earth	....	150,000	240 oiled earth	all E
Fulton	250,000	.....	....	Indef.	.....	.....
Henderson	87,560	earth	all but bridges E	92,900	earth-conc. bridges	all C
Jackson	50,000	grading, bridges	50,000 E,all C	126,000	8 gravel	all C
Jasper	none except bridge work	.....	....	none	1¼ gravel by twp.	all C
Jersey	51,000	.....	....	34,000	11 conc.	all C
Kane	360,000	10½ conc.	all C	1,100,000	7 conc.	7½ C
Madison	850,000	6½ brick, 22½ conc.	all C	257,000	very little	all C
Marion	.....	earth, $50,000 bridge	all C	.....	no hard road	bridges E
Massac	150,000	gravel	road dists. E 50% C	125,000	150 gravel	all C
McDonough	200,000	400 earth	70 E, rest twps.	200,000	400 earth	70 E, rest twp.
McHenry	222,000	1 conc., 3 bridges	all C	500,000	10 gravel, bridges 10 gravel bridges	bridges, hauling C
Monroe	42,000	3 mac.	2 E	45,000	3 mac.	all E
Piatt	20,000	.....	all C	40,000	.....	all C
Pike	12,000	gravel	½ E, ½ C	50,000	gravel	all E
Pulaski and Alexander	60,000	5 gravel	1½ C	375,000	30 gravel	all C
Richland	30,000	.....	....	35,000	earth-conc. bridges	twp. comrs.
Saline	none	.....	....	120,000	8 mac.	all C
Schuyler	75,000	concrete	100% E, 50% C	Indef.	1-15 conc.	all C
Scott	15,000	bridges, culverts, etc.	all E	10,000	oiling earth, bridges	most E
Stephenson	200 000	$100,000 bridges, rest earth roads	$50,000 E $100,000 C	450,000	5 conc., 3 rk. & grav.	3 E, 5 C
White	30,000 twp.	gravel	all C	40,000	gravel	all C
Williamson	60,000	3½ mac.	all C	105,000	.....	all C
Woodford	.....	7 graded earth	all C	10,000 4	graded earth	all C
Indiana:						
Clinton	281,781	8 grav., 3½ brick, 2 conc.	all C	1,005,852	15½ gravel, 5¼ brk. 16.67 conc.	all C
Crawford	20,000	5 mac.	all C	250,000	43 mac.	all C
Decatur	240,000	3 conc., 6 stone	all C	.....	8 conc., 12 stone	all C
Dubois	40,000	4 mac.	all C	300,000	30 mac.	all C
Fulton	100,000	gravel	all C	500,000	50 miles	all C
Howard	150,000	1 conc., 6 mac., 5 grav.	all C	600,000	½ asp., 7 conc., 8 stone, 15 gravel	all C
Jackson	200,000	gravel, mac., conc.	all C	150,000	5 gravel, 4 conc.	all C
Jennings	55,000	gravel, mac.	all C	63,000	gravel, 5 mac.	all C
Madison	123,000	concrete	all C	.....	$738,000 conc., $112,000 gravel & mac.	all C
Montgomery	.....	2 gravel rds.	all by twp.	.....	.....	all C
Morgan	175,000	½ mac., 10 grav., 8 stn.	all C	150,000	20 gravel & stone	all C
Newton	.....	1 mac.	all co.contract	800,000	73 mac.	all C
Posey	.....	15 gravel	....	.....	20 gravel	all C
Putnam	275,000	5 concrete	all C	550,000	20 mac., 10 gravel	all C
Ripley	32,100	1½ crush. stn., 1 con.	all C	300,000	7 conc., 20 stone	all C
Shelby	170,000	$30,000 stone, $35,000 conc., $105,000 gravel	all C	190,000	$96,000 stone, $15,000 conc., $79,000 grav.	all C
St. Joseph	300,000	3 concrete	all C	2,500,000	24 conc., 24 asp. pen., 20 gravel	all C
Tippecanoe	305,000	10 gravel	all C	800,000	6½ bit. conc., 1 asp. pen., 3 tarv., 2 grav.	tarvia E, rest C
Vigo	1,050,000	2 gravel, 4 conc., 1½ brick, 1 vibrolithic	$20,000 state $105,000 co. all C	7,000,000	25 brick & vibrolithic 40 gravel	all C
Iowa:						
Allamakee	70,000	none	....	185,000	$30,000 grade work, $30,000 grd. & mnt.	maint. E, $30,000 C
Appanoose	227,856.34	dirt	116,830 E, 111,026 C	200,000	200,000	90,000 E, 110,000 C
Beton	78,000	.....	all E	400,000	9 conc.	all C
Bremer	60,000	.....	....	160,000	11½ grading, 17 fed. aid	all C
Buena Vista	1,280,000	51 gravel	12 E, 39 C	140,000	20 gravel	6 E, 14 C
Cass	107,450	none	all E	235,530	none	$125,800 E

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. .It is hoped that others who have solved similar problems different will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

Value of Answers to Construction Questions

B. M. CRENSHAW
General Contractor
Livingston, Mont.

PUBLIC WORKS, April 11, 1921.
243 W. 39th Street,
New York, N. Y.

GENTLEMEN:

Recently you published under "Construction Questions Answered," our correspondence in regard to the classification of hand rail concrete. This publication has become quite valuable to me as it has been the means of my obtaining from the State Highway Commission the proper classification of the hand rail cement. However, my copy has disappeared, and I think that the highway engineers have probably, after reading same, placed it in a coat pocket and forgotten to return it.

I should like to obtain about five copies of the magazine which contains the article mentioned, as I wish to send one to a consulting engineer on a big project in Canada, and other engineers of my acquaintance. . . .

I certainly appreciate the help that you have been to me in this connection. Your magazine is read in my works by all the men, and the article about the hand rail received much comment.

Thanking you most sincerely, I remain,

Yours truly,
B. M. CRENSHAW.

What Are the Essentials of Cost Keeping Accounts?

Flexible system of classification and subdivision of items, accurate records, simple key system, distribution of overhead and fixed charges, low cost and immediate availability, automatically showing condition of work and comparison with estimate.

Portland, Ore., March 15, 1921.

PUBLIC WORKS,
243 W. 39th Street,
New York City.

Gentlemen: We are figuring on making some changes in our methods of time-keeping and cost accounting on 1921 contracts.

No doubt you are in touch with some firm who has already worked out forms suitable for handling detailed costs on sewer, water and road construction work. If so, we will be pleased to have you request them to communicate with us, sending sample forms, time sheets, etc.

Thanking you in advance, we are,

Yours very truly,

* * * * *

Cost keeping is essentially intended to provide detailed data regarding the cost of different items of construction, so that they may be readily accessible, separately and classified, for the entire work and available for exact records of the work already done and for rational estimates of similar work or as a basis or modification of estimates for work which differs in amount or conditions from that already accomplished.

REQUIREMENTS FOR DATA

The records must, therefore, give complete information regarding all portions of the work in such a manner that they can be segregated or combined, not only to cover the different structures or parts of structures, but so as to give the amounts and unit costs of different sorts of primary operations, such as excavating, concreting, pile driving and the like.

The degree of refinement, and consequently the amount of detail in the accounting, varies widely with the class of construction and local conditions and still more with the arbitrary requirements of classifications. Many of the operations also can be considered as simple or compound items or they can be treated as a number of supplementary items, as, for instance, in rock excavation, where, if there is only a comparatively small quantity executed at brief intervals by men temporarily released from other operations, it may be only necessary to record the total number of man-hours required, total costs of explosives and of yardage excavated; while for other cases it may be necessary to record also the character of rock, dimensions of cut, time spent in stripping, drilling, loading, firing, mucking and loading, details of supplies and equipment, and other information.

In any event, the amount of detail should be carefully determined so as not to be in excess of the requirements and still to give all essentials for the specific class of construction or kind of operation. The classification should be determined in conference with the estimator that will use them and in accordance with classifications and unit prices in the specifications and standard for this class of work.

DIRECT AND INDIRECT

The classified cost includes not only the direct but the indirect items that enter into the finished work. They must therefore embrace labor, materials, supplies, equipment, supervision, overhead and fixed charges. A definite system must be devised for distributing the latter classes of costs so as to provide a fair apportionment and not omit important factors that are sometimes

overlooked and may make all the difference betweent profit and loss.

Overhead charges may be considered as those that belong essentially to the general established business of the contractor and are not special for this particular job, but apply to other work under construction by the same party. Overhead charges should include the percentages carefully calculated that this job must pay toward the maintenance of the central office, legal and contracting expenses, general transportation, salaries of all general officials, emergency funds, interest, maintenance, amortization fund, if any, and, in fact, all expenses necessary to carry on the general business irrespective of any particular contract.

Fixed charges cover those necessary expenses not included in the direct outlay for labor, materials, supplies and equipment not dependent upon the system of operations or items of work, as, for instance, premium on surety bonds, interest on borrowed money, fire and accident insurance policies, local rent, camp and hospital charges, commissary and local office expenses, special appropriations for explorations, general supervision, royalties, licenses, permits, replacements and delays.

SUPPLIES, MATERIALS AND EQUIPMENT

Supplies and materials should, of course, be charged and credited as per the stock account kept, showing when ordered, received, inspected, stored, requisitioned, used and returned, with shrinkage and depreciation. This provides an automatic perpetual inventory, the same as should be maintained for equipment.

A very careful account should be kept of all equipment, including machinery, tools and plant of every description, whether permanent plant, or purchased and sold at the beginning and end of the job, or rented, or built, or rebuilt, and items repaired or resold. Liberal depreciation allowances should be attached to record of time plant was actually in service and charges for idle time. The cost of hauling, handling, installation and removal, operating, supplies, renewals and repairs should also be kept.

SYSTEM OF CLASSIFICATION

The main heads for classification of costs of highway construction might include, for example, fixed charges, overhead, supervision, accounting, purchasing and inspection, transportation and freight, machine equipment, small tools, fuel, materials and supplies, auxiliary construction, temporary construction, commissary, hospital, repairs and renewals, rock excavation, earth excavation, embankment, hauling earth and rock, unloading materials, storing materials, delivery of materials, mixing concrete, placing concrete, finishing concrete, protecting concrete, water supply, ditches, culverts, retaining walls, hand rail, curbs, gutters, producing sand and stone and miscellaneous.

Labor should, of course, be classified according to trades and the amounts charged to different operations on various kinds of construction, as aforementioned, should exactly balance the total time reported.

SUBDIVISIONS OF OPERATIONS

The number and character of the items depends entirely on the requirements of the classifications. The concrete mixing may be assumed as a single unit or it may be divided into installation of mixing machine, operation of machine, power and oil for machine, removing machine, measuring and delivering sand, gravel, cement and water, protecting materials, heating materials, etc.

The concreting may include setting and removing forms, delivery of concrete, spreading and leveling of concrete. Finishing the concrete may include rolling, ramming, belt finish, making expansion joints, protecting with screens, covering with earth, watering, removing earth, miscellaneous.

EQUIPMENT AND MAINTENANCE

Under Equipment, the heading Automobiles and Trucks may include superintendent's car, service car, trucks of various sizes and patterns, trailers, extra parts, gasoline, oil, tires, garage rent, labor in machine shop, machine shop overhead, chauffeurs, mechanics and helpers, light, insurance, depreciation and miscellaneous.

Accounts should be kept for concrete mixers, hoisting engines, compressors, boilers, pumps and engines, dynamos, motors, steam shovels, rollers, tractors, excavators, locomotives, drills and all other important machinery should be charged every day that they are located on the job and credit should be given for all services performed by them. These records show the efficiency of equipment or the loss through idle or waiting time and breakdowns.

Total cost of all important work and any important parts of it should be plotted on cross-section paper with the cost units measured vertically and the time measured horizontally, thus showing the actual cost from day to day by a full line above or below or intersecting the horizontal line, which should represent the estimated cost.

SEWERS AND WATER WORKS CONSTRUCTION

Sewer work and water works construction costs should be kept in a similar manner, itemized to suit the different conditions. Some of the items common to both will be city permits, safeguarding and diverting traffic, removing and replacing pavements, removing or reconstructing or safeguarding existing pipes, conduits and the like, excavating, trench sheeting, trench bracing, pumping, blasting and removing spoil, preparing sub-grades, building foundations, testing the line, backfilling, installation of derricks, operation of derricks, moving derricks, laying, shifting and removing industrial track, superintendence, inspection and miscellaneous.

In addition, the work for concrete sewer construction includes hauling, unloading, storing cement, aggregate, and sand; installing concrete mixer, operating mixer, delivering concrete, building forms, moving, cleaning and repairing forms, depositing concrete, rebuilding curbs, sidewalks, foundations, manholes, various other items and miscellaneous.

For laying water pipes, delivery of pipes, installation of derricks, hauling pipes, assembling

pipes, preparing and pouring joints, testing pipes, other items and miscellaneous.

KEY NUMBERS

In order to simplify the records and save time the classification should be keyed with a system of letters and numbers that will automatically indicate the characters of the items. For instance, all labor may be classified L, all equipment E, supervision S, materials M, supplies Su, and so on, with a few extras reserved for additional developments. Each division, such as surveying, paving, hauling, trenching, pumping, concreting, pipe driving and the like should have a series of ten numbers or more, as from 1 to 10, from 10 to 20, 20 to 50, and so on. For instance, if grading is from 1 to 10, rock excavation may be 1, boulders 2, dry earth excavation 3, mud excavation 4, hauling 5, backfill 6, and miscellaneous 9. Miscellaneous should always be added to every set to provide for things not easily classified.

Excavation may be again subdivided and each final item follow a decimal point so that 1.1 might be stripping, 1.2 drilling, 1.3 explosives, 1.4 blasting, 1.5 mucking, 1.6 rock drilling, 1.7 sledging, 1.8 loading, 1.9 miscellaneous. Care should be taken not to sub-divide different items too minutely, thus producing elaborate and complicated records that are costly to maintain and perplexing to handle.

Whatever system is adopted should be complete and accurate, positive and simple, without repetition or ambiguity, flexible to the different and changing conditions and to allow for more or less detail. It should be available daily for inspection, for purposes of comparison, revision, it should be inexpensive and it should be keyed with the regular time-keeper's and accounting records. Distributing of time should be such that the total time and cost of labor should check exactly with the sums for different operations.

EXPLANATORY AND DESCRIPTIVE

The cost account of any given piece of work should be accompanied by a very complete and concise description of the work and its condition describing the principal features, location, requirements, difficulties, methods, plans and equipment giving important facts such as the character of the rock, depth of excavation, length of haul, amount of traffic, character of labor, delivery of material and supplies, character of machinery and equipment and all other features that influence the methods and efficiency of the work and the character of operations for increase or decrease in cost.

Both the estimated and final actual quantities of cost and time should be given. These data should be accompanied by a diary containing entries for the amount and character of work, the working forces, the operation of machinery and inspection of materials, progress made, weather conditions and developments for each day. Special pains should be taken to note any deviation from specifications or contract and any agreements made or directions received from the engineer, architect or owner. These should be initialed by the official giving them, especially if it is necessary to act on them before formal written notice is received.

IMMEDIATE AVAILABILITY

Unit costs, costs of structure and total costs, actual and estimated, should be prepared daily and put in the record book, plotted on diagrams, and given to the superintendent so that the condition of the job may be instantly evident by inspection and so that excessive costs or delays can be noted and remedied immediately. Both records and diagrams will also show the relative progress of different portions of the work and the men and equipment that are available for shifting from point to point to equalize the work or to expedite it in case of emergency. Record cards for each foreman should be headed with the classification letter and general number columns for the different entries and lines for the details of operations corresponding to the units and decimals. All cards should have a line for miscellaneous work and every unclassified item must be fully described.

The Staten Island Tunnel

A bill has been passed by the New York Legislature, signed by the Mayor of New York City and now awaits the expected signature of the Governor of the state, to authorize the construction, by the City of New York, at its own cost, of a freight and passenger tunnel connecting the borough of Brooklyn and Richmond.

An appropriation has been made providing for the surveys and borings on two lines approximately from 65th street to St. George, and from 85th street, Brooklyn, to Rosebank, Staten Island, and if the bill becomes law, the preparation of design, specifications, and award of contract are expected to follow promptly. The bill authorizes the cities to construct the tunnel and lease it for operation to some party determined by the Board of Estimate.

This tunnel project is entirely separate and distinct from that long under consideration by the Public Service Commission, whose engineers are studying four alternate routes for tunnels to Staten Island and have recently made an appropriation of $50,000 for soundings and explorations.

Refuse Disposal in Passaic

(*Continued from Page* 369)

The city owns one 4.5-ton Four-Wheel Drive (F. W. D.) tractor. It will still use its own horses in the block collection of the garbage and ashes, etc.

All expenditures for collection and incineration will be paid from the general treasury, no direct charges being made for collection. Pails and ash cans are set out on the curbs by the householders and returned by them, and this practice will be continued. The total yearly cost of the collection has averaged, during the past five years, $37,750 for labor and teams. Labor on the dumps has averaged $1,000 a year.

Recent Legal Decisions

CONSTRUCTIVE NOTICE TO CITY AUTHORITIES OF DEFECT IN STREET FOR JURY

The general rule is well established that the facts and circumstances of each case must determine whether constructive notice of a defect in a street is to be attributed to the municipal authorities, and ordinarily this is a question for the jury. There are many elements which may properly be considered by the jury in passing upon this question. No definite rule as to the length of time a defect must have existed to furnish notice to the municipal authorities can be fixed by the court, and whether notice shall be imputed to the city authorities is ordinarily a question for the jury to determine from the length of time the defect has existed, the nature or character thereof, the publicity of the place where it exists, the amount of travel over the street, and any other facts or circumstances in evidence which tend to show notoriety, and from which they may conclude that by the exercise of ordinary and reasonable care and diligence the defect should have been discovered by the corporate authorities. In an action for damages for injuries caused by being thrown from a cart when the horse drawing it stepped into a hole in a bridge caused by a broken plank, the question of constructive notice was held for the jury. City of Greenville v. Middleton, Mississippi Supreme Court, 86 So. 804.

VALIDITY AND SCOPE OF MUNICIPAL DAY-LIGHT SAVING ORDINANCE

The Ohio Supreme Court holds, State ex rel. Cist v. City of Cincinnati, 129 N. E. 595, that an ordinance adopted by the electors providing that the standard of time for the regulation of purely municipal affairs shall be from the last Sunday in April to the last Sunday in September that of the seventy-fifth meridian of longitude west of Greenwich and from the last Sunday of September to the last Sunday of April one hour later, though in conflict with sections 5979 and 5980 of Ohio General Code, is authorized by Section 3, art. 18, commonly known as the home rule amendment to the Constitution. The ordinance requires only that the purely municipal affairs of the city should be regulated by the standard of time thus adopted. It purports only to prescribe a standard of time which shall apply to required acts of any board or officer of the municipality. The standard of time prescribed by the law of the state would govern and control as to all matters except those having to do solely with local governmental action and procedure.

CITY'S FAILURE TO FOLLOW STATUTORY PROCEDURE MAKES ASSESSMENT UNENFORCEABLE

The Florida Supreme Court holds, Carr v. City of Kissimee, 86 So. 699, that when the method and procedure for the enforcement of a lien for sidewalk construction is prescribed in the act authorizing the improvements, the city is bound to follow the method and procedure prescribed, and the failure to do so makes an assessment for such tax unenforceable.

WHAT IS COVERED BY THE TERM "LOCAL IMPROVEMENT"

Holding that an ornamental street lighting system is a local improvement which may be paid for by the levy of a special assessment, the Illinois Supreme Court says, City of Springfield v. Springfield Consol. Ry. Co., 129 N. E. 580, that the only essential elements of a local improvement are those which the term itself implies, viz., that it shall benefit the property on which the cost is assessed in a manner local in its nature, and not enjoyed by property generally in the city. So it was held in Northwestern University v. Village of Wilmette, 230 Ill. 80, 82 N. E. 615, that whether or not the improvement will be a benefit to all the property in the village is not the test. If the improvement will enhance specially the property adjacent to which it is made, the improvement is a local improvement. It has been uniformly held in Illinois that, although the construction of a general system of water works for fire protection and general use is not a local improvement, the laying of water mains for the distribution of water along a particular street for the use of residents is a local improvement which may be paid for by special assessment. In Ewart v. Village of Western Springs, 180 Ill. 318, 54 N. E. 478, the same doctrine was applied to the construction of a plant and system for lighting the streets by electric light, including the power house, generator engine, electric conductors and lamps and necessary appurtenances. After a consideration of the cases in regard to the construction of water works by special assessment, it was held that, so far as the plant for lighting the streets by electricity included the power house and electric generator engine, it might be regarded as an improvement of general utility which could not be constructed by special assessment, but that the poles, wires and lamps which are the means of furnishing the necessary light for the protection of the property of citizens constituted a local improvement.

INCREASE OF HYDRANTS RATES NOTWITHSTANDING FRANCHISE FIXING RATES

The Indiana Supreme Court holds, City of Washington, Ind., v. Public Service Commission, 129 N. E. 401, that the revision of the contract price at which water should be furnished to a city for use in extinguishing fires, under a franchise ordinance fixing the rate to be paid, is as completely within the rate-making power of the state as is a revision of the rates to be charged private consumers. To whatever extent, if at all, the power of the state to increase rates might be limited as against the city by reason of such a franchise contract, it is obvious that the rates charged other consumers would have to be increased in proportion if the water company were to be given the income which the law allows it to earn.

NEWS OF THE SOCIETIES

Apr. 26—ROCHESTER ENGINEERING SOCIETY. Joint meeting with the ROCHESTER ROTARY CLUB.

May 2-4 — MISSISSIPPI VALLEY ASSOCIATION. 3d annual convention. New Orleans, La.

May 4-7 — NATIONAL FOREIGN TRADE CONVENTION. 8th convention. Cleveland, Ohio.

May 5 — BALTIMORE SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with the Engineers Club of Baltimore.

May 5 — ROCHESTER SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint dinner of the professional engineers of Rochester, Powers Hotel.

May 6 — VANCOUVER SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

May 9 — HARTFORD BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Get-together dinner at City Club.

May 9-11 — AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo.

May 9-11 — NATIONAL CONFERENCE ON CITY PLANNING. Pittsburgh, Pa.

May 9-12 — SOUTHWEST WATER WORK ASSOCIATION, Shirwin Hotel Headquarters, Oklahoma City, Okla.

May 10-12 — CANADIAN GOOD ROADS ASSOCIATION. 8th annual convention. Halifax, Can. Secretary George A. McNamee, Montreal.

May 16-18—AMBASSADORS & MINISTERS OF WORLD TRADE. Conference under auspices of NATIONAL ASSOCIATION OF MANUFACTURERS. New York City.

May 17 — CLEVELAND SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual dinner.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne, Ind.

May 18—BIRMINGHAM SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual business meeting. Southern Club.

May 19—EASTERN NEW YORK SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Edison Club Hall, Schenectady.

May 19 — SAN FRANCISCO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

May 20 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, 370th meeting. Engineering Societies Building, New York City.

May 20 — PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual dinner, Hotel Adelphia Roof.

May 21 — ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with ATLANTA SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

May 23-26 — AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting. Congress Hotel, Chicago.

May 31-June 3—NATIONAL ELECTRIC LIGHT ASSOCIATION. Pasadena, Cal.

June 15-17—LEAGUE OF MICHIGAN MUNICIPALITIES. Kalamazoo, Mich.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

AMERICAN ENGINEERING COUNCIL

At the Philadelphia meeting, Herbert Hoover resigned as president, giving as his reasons the fact that American Engineering Council by its constitution was necessarily engaged in furthering national activities which involve legislation; and that he as a member of the executive branch of the government could not consistently direct such activitv as an officer of American Engineering Council.

One of the most important matters before the council was the report of the Committee on Elimination of Waste in Industry. Shop managers will find in the report a method of measuring the relative standing of their organizations and will find positive suggestions as to improved methods. The questionnaire has fundamental value, because of the pertinent leading questions it asks concerning means of production and the other aspects of management.

The finding will indicate the major factors which contribute to waste and their relative weight. It will suggest those long-time programs such as standardization and stabilization which are larger than the action any one group can take for itself.

The finding will indicate how each form of waste has been reduced or eliminated in certain industries, citing the specific instances.

Standardization alone will account for immense savings and the elimination of very costly wastes. Stabilization of manufacturing will remove some of the most serious causes of labor unrest and go a long way toward inaugurating a regime of co-operation between management and men. These changes can only be accomplished by directed group action. The report of the executive secretary gave the results of a special study of the Employment Service. Plans for broadening the scope of the service were recommended and adopted.

Dealing with the licensing and registration of engineers, the report said that this had been a very active feature of the council's legislative program. The council does not believe that such legislation is necessary, but where such is to become a fact it is interested in seeing that the legislation passed is of such character as to be beneficial both to the public and the engineering profession.

Other matters discussed by the secretary were petitions of the council for the appointment of an engineer as Assistant Secretary of War, in which favorable action was not obtained, and for the appointment of an engineer to the Interstate Commerce Commission, which is still under consideration; a request from the engineers in the public health service for co-operation in legislation that will give them professional standing and closer relations with the government departments both in giving appropriate counsel and in obtaining information which in the form of a bulletin service is being sent out in increasing volume to engineers in member societies.

The report of the Public Affairs Committee was adopted. This report recommended continuance of the public works campaign, to promote which the organization of the National Public Works organization will be continued. The Committee on New York State Government Reorganization reported that an elaborate report has been submitted to Governor Miller and the Judiciary Committees of both houses of the legislature presenting the engineering point of view as to the making over of the state government. This report has been widely noticed in the press and is having substantial influence on the question of remoulding the state administrative system.

Three new member societies have joined the Federation since the last meeting. They are the Boston Society of Civil Engineers and the Engineering Societies of Milwaukee and Duluth. Other important additions to the Federation's swelling membership and influence are expected to be announced before July 1.

The dinner, April 16, arranged in honor of Mr. Hoover by the Engineers' Club of Philadelphia, representing more than 4,600 engineers in the Philadelphia district, was the culminating event of the meeting of the American Engineering Council of the Federated American Engineering Societies.

More than 600 attended the dinner, which was held at the Bellevue-Stratford Hotel. Many of the leading citizens of Philadelphia were present as well as members of American Engineering Council. Mr. Aertsen presided and the other speakers included Dean Dexter S. Kimball, whose subject was "The Federated American Engineering Societies"; George Wharton Pepper, Col. William A. Glasgow and John C. Trautwine, Jr., all of Philadelphia. Mr. Pepper, foremost lawyer and publicist, made a brilliant speech in which he asserted that Mr. Hoover was more than engineer and as such he was an example for the engineering profession. Mr. Pepper, whose remarks concluded the speechmaking, appealed for a broader engineering training and greater participation by the engineer in the affairs of the state. Mr. Trautwine's subject was "The Engineers of Philadelphia." Col. Glasgow, close friend and fellow-worker of Mr. Hoover in relief work abroad, paid a tribute to Hoover the Man. Love of country and fidelity to its institutions was urged by every speaker, all of whom said that the engineer was becoming one of the most powerful agencies of the state, socially, economically and politically.

Mr. Hoover's address emphasized the vital national need of government reorganization and outlined an increased sphere of activity for the department of commerce, of which he is now the head.

Dean Kimball's address was an elaborate and convincing answer to those who ask why engineers should join the federation.

Mr. Aertsen's address was a eulogy of the career of Herbert Hoover.

N. Y. STATE ASSEMBLY, AMERICAN ASSOCIATION OF ENGINEERS

At a meeting held on March 12 at Albany, N. Y., the New York State Assembly of the American Association of Engineers was organized to co-ordinate the activities of all the chapters and clubs of the A. A. E. in the state on state matters, and to co-operate with the state section of the Federated American Engineering Societies and other organizations.

The following officers were elected: President, S. J. Stone; first vice-president, A. M. Knowles; second vice-president, G. F. Scharbach; and secretary-treasurer, J. G. Brennan.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The spring meeting of the American Society of Mechanical Engineers will be held in Chicago on May 23-26 at the Congress Hotel. On May 21 an excursion jointly with the S. A. E. will be made to McCook Field, Dayton, and following the meeting on May 27-28 an excursion will be made to Rock Island Arsenal with the Army Ordnance Association.

Interesting recent discussions at section meetings were "The Development of Modern Industry," by Dean Dexter S. Kimball, of Cornell, at the Rochester meeting on April 11; "The Gas Fired Steam Plant of the San Joaquin Light & Power Co.," by A. T. Meidell, of that company, at the April 14 meeting of the San Francisco section; and others contemplated are those to be presented at the regional meeting in the South on April 22 by representatives of each section, when a visit is planned to Chickasaw plant for inspection of the shipyard and power plant; and the paper on "Hydro-Electric Power Plants" by C. G. Adsit, of the Georgia Railway & Power Co.

PROFESSIONAL ENGINEERS OF ALBERTA

At the annual meeting of the Association of Professional Engineers of Alberta, held in Edmonton on March 26, the following officers were elected. President, R. A. Brown; vice-president, G. W. Craig; councillors, L. B. Elliot, T. Schulte, B. L. Thorne, Prof. C. A. Robb and Prof. R. S. L. Wilson.

VERMONT SOCIETY OF ENGINEERS

At its annual meeting on March 9, the Vermont Society of Engineers was addressed by Governor James Hartness on the proposed affiliation of this society with the Federated American Engineering Societies, and by Alfred Patche on modern engineering in Syria. The following officers were elected: President, M. E. Carpenter; vice-president, G. R. Varnum; secretary, G. A. Reed; and treasurer, T. W. Dix.

KANSAS SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS

A Kansas City section of the American Society of Civil Engineers was recently organized with the following officers: President, Alexander Maitland; vice-presidents, John V. Hanna and Col. E. M. Stayton; director, Louis R. Ash; and secretary-treasurer, Henry C. Tammen.

ILLINOIS AND IOWA SECTIONS, AMERICAN WATER WORK ASSOCIATION

A joint meeting of the Illinois and Iowa sections of the American Water Works Association was held on March 23-24, at which five middle states were represented. Technical papers were presented and an excursion to Chicago pumping stations made. R. Edman Greenfield explained the term hydrogen-ion concentration; S. A. Greeley gave comparative operating data of the Evanston, East Chicago and Whiting rapid sand filters; Walter A. Shaw and C. M. Ross discussed the matter of fixing rates for public utilities by contract; F. H. Mathews discussed the grading of utilities from the layman standpoint; D. H. Maxwell discussed the geological difficulties of Bloomington, Ind., in finding a reservoir site that will hold water; and John Ericson showed that Chicago could not afford to filter its supply until it reduced its waste. All of these papers were most interesting.

The Illinois section elected the following officers: Chairman, John W. Alford; vice-chairman, Henry R. Ringness; treasurer, H. E. Keeler; and new trustee, Dr. A. M. Buswell.

LOUISIANA ENGINEERING SOCIETY

The regular meeting of the Louisiana Engineering Society was held on March 14 at 8 p. m. The technical exercises of the evening consisted of a paper entitled "The Financing of Road Construction," by Hon. Harry P. Gamble.

CONFERENCE OF IOWA ROAD OFFICIALS

The eighth annual conference of Iowa Road Officials was held at Ames, Ia., on March 23-24, inclusive. The program included numerous papers on road building, road assessments, contracting problems, highway bridges, transportation, pavements, road maintenance and other subjects of interest to road officials.

MASSACHUSETTS HIGHWAY ASSOCIATION

At the annual meeting of the Massachusetts Highway Association, held at Boston on February 24, the following officers were elected for the ensuing year: President, Henry V. Macksey; vice-president, Robert P. Marsh; secretary, John A. McCarthy; treasurer, Charles A. Brown; and directors, John A. Gaffey and Henry A. Spates.

NEW HAMPSHIRE GOOD ROAD ASSOCIATION

The regular quarterly meeting of the New Hampshire Good Roads Association was held at Concord on March 10, and was attended by about 75 members. Officers for the coming year were elected as follows: President, Harry L. Smith; and secretary-treasurer, Jerry Killory; first vice-president, C. M. Parks, and directors, Ovid F. Winslow and F. H. Colburn.

NEW YORK STATE ROAD BUILDERS' ASSOCIATION

The New York State Road Builders' Association held its annual election on March 18, at which the following officers were elected: President, John H. Gordon; vice-president, C. J. Hendrickson; and trustees, William G. Fox and Louis Mayersohn.

SOUTHERN PINE ASSOCIATION

The sixth annual meeting of the Southern Pine Association was held at the Grunewald Hotel, New Orleans, La., April 5 and 6.

In addition to the regular program many interesting exhibits were made and charts displayed, showing the work of the association, the use to which lumber and its by-products can be put, and the latest statistics and graphic charts showing economic conditions affecting the lumber industry.

The principal papers, addresses, discussions and reports included "What the Southern Pine Association Has Done for the Industry and the Public," report of Secretary-Manager J. E. Rhode. "The Contention of the Government," statement by Judge John H. Lucas, chief counsel, Southern Pine Association, Kansas City, Mo. "Trade Associations Essential to Successful Business," Judge L. C. Boyle, counsel, National Lumber Manufacturers' Association, Washington, D. C. "Governmental Control Stifling National Development," Mr. Chas. S. Keith, Kansas City, Mo., chairman, committee on economics, Southern Pine Association. "Engineering Problems Affecting the use of Southern Pine," Mr. Geo. E. Strehan, consulting engineer, Southern Pine Association, New York City. "Waste Prevention and Utilization," Mr. C. E. Paul, construction engineer, National Lumber Manufacturers' Association, Chicago, Ill.

PERSONALS

Longstreet, S. P., recently in charge of the Scranton district, Pennsylvania State Highway Department, has been appointed chief engineer of the Philadelphia district.

Swift, C. J., has been appointed highway engineer of Blue Earth Co., Minn.

Moore, E. F., has been appointed assistant chief engineer of the Sanitary District of Chicago.

Jenkins, Everett W., formerly with the engineering department of Worcester, Mass., has been appointed superintendent of streets of Quincy, Mass.

Allen, James, has been appointed supervisor of highways for the State of Washington.

Nicolett, P. M., has been appointed city engineer of Graham, Texas.

McElherne, J. C., formerly with the state highway commission at Rochester, has been appointed engineer of Rice county, Minn.

Preston, P. J., project manager of the U. S. Reclamation Service, Uncompahgre Project, Montrose, Colo., has been transferred to the Yuma Project, and Foster, L. J., has been appointed to his position.

McGill, R. D., is project engineer in charge of federal aid project No. 16, consisting of road construction on the Kimball-Harrisburg highway.

McCamy, C. C., has been appointed city engineer of Dalton, Ga.

Ford, E. Paul, has been appointed city engineer of East San Diego, Cal.

Eckart, N. A., formerly construction engineer of the Hetch Hetchy Water Supply, with headquarters at Groveland, Cal., has been appointed chief assistant city engineer under City Engineer M. M. O'Shaughnessy.

MAY 10 1921

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

QUALITY TANKS, BODIES AND HOISTS

The equipment manufactured by the Heil Co. includes a number of special steel truck bodies with and without dumping hoists, intended for various kinds of service and for general contractors for hauling purposes. There are several models with rear and side gates for handling coal. Standard bodies are from 4½ feet to 6 feet wide and from 9 to 12 feet long, and are made 3 inches wider at rear than in the front with the sides strengthened by flanges. They are equipped with single acting tail gate with 100 per cent manual control. Various models are made with square and with round corners and with straight or flared sides.

ASPHALT BODY WITH LAYER OR ASBESTOS BETWEEN INNER AND OUTER SHELLS

The bodies are provided with auxiliaries including double acting tail gate, mud guards, swinging partitions, wearing plate and four sizes of hydro-hoists that are mounted on the chassis frame in front of the rear axle and take power from the front propeller shaft or transmission amidships applied through universal joints to the pump drive. The hoist can be pumped up to develop a lifting power of more than 34,000 pounds and is provided with a safety device that insures the lowering of the body at a constant rate of speed.

There are also truck tanks for gasoline and other liquids that are furnished with can box, sills, can racks, piping and faucets mounted on the chassis.

Garbage bodies with capacities of 2, 3, 4 and 5 tons have the lower half of the bodies water tight and are furnished with or without covers. Those that are without covers are provided with loops so that a canvas can be tied over the top. Asphalt bodies made in 6 sizes with capacities of 2½ to 6 tons, also have the manual tail gate control operated by a lever at the driver's seat. They are made with asbestos 3 inches thick between inner and outer steel shells.

BROWING LOCOMOTIVE CRANES

Locomotive cranes manufactured by Victor R. Browning are of 7½-ton and 10-ton capacity and are mounted on standard gauge flat cars or on crawler traction.

Hoisting, rotating and traveling can be performed simultaneously. There are two main hoisting engines with drums driven by spur gearing and provided with band friction clutches actuated by a steam ram installed on the master gear. The boom is raised or lowered by gears and a worm wheel operated by a positive clutch.

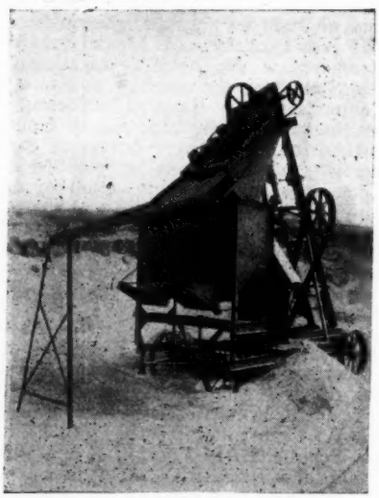
The crawler crane can travel anywhere that motor power can go, irrespective of road or soil conditions and has a crawler belt composed of individual pads constructed of either armor plated wooden blocks, or entirely of steel, and so arranged that the driving power is equalized through the entire machine. The 40-foot boom operates either a ¾ or a 1¼-yard bucket and can be replaced by a 20-foot steam shovel boom equipped with a 7/8-yard dipper and crowding engine, which can be operated at variable radii and dumped as high as 18 feet above floor level or 25 feet from the center of the machine.

With little change the crawler crane can also be easily converted into a ¾-yard drag-line excavator. The crawler can make very short turns, can travel equally well through mud, sand, or on rocky ground, and can surmount grades of 40 per cent without overloading the engine. The machines may be driven by steam, electric or gasoline power.

WATERTIGHT GARBAGE BODY WITH ELECTRICALLY WELDED SEAMS

WHIP-TAP SAND AND GRAVEL SCREENS

Portable whip-tap screens manufactured by the W. S. Tyler Co. are recommended for road work because they produce to specifications at less cost than by any other means, thus saving freight and hauling, can be operated in winter, handle wet, dry or sticky material, and only require ten minutes for changing the screen.



PORTABLE WHIP-TAP SCREEN

The important principles involved are drum head screen tension, and continuous unchecked vibration. The screening surface being kept constantly alive secures maximum tonnage of thoroughly screened material.

JACK OF ALL EXCAVATORS

This machine, manufactured by Pawling & Harnischferger Company, has an adjustable 30-foot steel boom revolving on a steel platform supported by steel front wheels and rear caterpillar traction. It has a locomotive crane which has a lifting capacity of 15,200 pounds at 8-foot radius, and can be equipped with a Page or clamshell bucket for many kinds of excavation, loading and handling loose materials, or with a drag-line or orange peel bucket. It has a 40 h. p. gasoline motor, a drag-line pull of 9,500 pounds and a locomotive speed of 100 feet per minute and a swinging speed of 3 and 4/10 per minute. It can be shipped without dismantling and is operated by one man, not a licensed engineer.